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BIOTA OF FRESHWATER ECOSYSTEMS. IDENTIFICATION MANUAL NO. 3. FRESHWATER SPHAERIACEAN CLAMS (MULLUSCA: PELECYPODA) OF NORTH AMERICA

J. B. Burch

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16. Abstract Bivalved mollusks of the superfamily Sphaeriacea (Order Heterodonta) are represented in North America by 34 native and four apparently introduced species of the cosmopolitan freshwater Sphaeriidae and by one introduced species (*Corbicula manilensis*) of the Afro-Oriental family Corbiculidae. The North American Sphaeriidae include three genera: *Sphaerium* with 12 species, *Pisidium* with 25 species, and *Eupera* with one species. The genera *Sphaerium* and *Pisidium* are world-wide in distribution and occur in all North American states and provinces. *Eupera* is restricted to the Western Hemisphere: northern South America, Central America and the southern Coastal Plain of eastern North America.

Although characters of soft anatomy are used in taxonomy of the Sphaeriacea, especially in the classification at the generic level and above, all taxa can be identified readily by characters of the shells, and such shell characters are particularly important in distinguishing the species. The main feature of this publication is an illustrated taxonomic key using shell characters for identification of the 39 species of North American Sphaeriacea. (EPA)

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Identification Manual No. 3

FRESHWATER SPHAERIACEAN CLAMS (MOLLUSCA:PELECYPODA) OF NORTH AMERICA

by

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for the

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FOREWORD

"Freshwater Sphaeriacean Clams (Mollusca:Pelecypoda) of North America" is the third of a series of identification manuals for selected taxa of invertebrates occurring in freshwater systems. These documents prepared by the Oceanography and Limnology Program, Smithsonian Institution for the Environmental Protection Agency will contribute toward improving the quality of the data upon which environmental decisions are based.

Additional manuals will include, but not necessarily be limited to, freshwater representatives of the following groups: amphipod crustaceans (Gammaridae), branchiuran crustaceans (*Argulus*), isopod crustaceans (Asellidae), decapod crayfish crustaceans (Astacidae), leeches (Hirudinea), freshwater planarians (Turbellaria), polychaete worms (Polychaeta) and aquatic dryopoid beetles (Dryopoidea).

ABSTRACT

Bivalved mollusks of the superfamily Sphaeriacea (Order Heterodonta) are represented in North America by 34 native and four apparently introduced species of the cosmopolitan freshwater family Sphaeriidae and by one introduced species *(Corbicula manilensis)* of the Afro-Oriental family Corbiculidae. The North American Sphaeriidae include three genera: *Sphaerium* with 12 species, *Pisidium* with 25 species, and *Eupera* with one species. The genera *Sphaerium* and *Pisidium* are world-wide in distribution and occur in all North American states and provinces. *Eupera* is restricted to the Western Hemisphere: northern South America, Central America and the southern Coastal Plain of eastern North America.

Although characters of soft anatomy are used in taxonomy of the Sphaeriacea, especially in the classification at the generic level and above, all taxa can be identified readily by characters of the shells, and such shell characters are particularly important in distinguishing the species. The main feature of this publication is an illustrated taxonomic key using shell characters for identification of the 39 species of North American Sphaeriacea.

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SECTION I

INTRODUCTION

The Sphaeriacea are represented in North America by 38 species of the family Sphaeriidae (four of which are apparently introduced), and by one introduced species of the Afro-Oriental family Corbiculidae.

The Sphaeriidae is one of the truly cosmopolitan families of freshwater mollusks. Its members are the "pea", "pill" or "fingernail clams", and at least one of its many species can be found in almost any body of freshwater. Until recently the classification of these obscure bivalves seemed hopelessly confused because of the plethora of names based on nearly every minor form of shell variation (e.g., see "Synonymy" in Herrington, 1962, p 52-54).

The Sphaeriidae as recognized here contain four genera: *Sphaerium*, *Pisidium*, *Byssanodonta* and *Eupera*. *Byssanodonta*, characterized by an entirely smooth hinge and the total absence of teeth, is limited in distribution to South America. *Eupera*, like *Sphaerium* and *Pisidium*, has an articulating hinge with cardinal and lateral teeth, but differs from those two genera by having only one cardinal tooth in each valve. In addition, *Eupera* exhibits several distinctive differences in soft anatomy from both *Sphaerium* and *Pisidium*, and each of the latter two genera are also quite distinct in soft anatomy. These differences have been considered basic enough to warrant separate subfamilies for each of the three genera occurring in North America (Heard, 1965a). Their diagnostic characters are given below.

Subfamily Sphaeriinae Baker, 1927

> Branchial and anal siphons are both present and partially fused together (for the greater part of their length in the subgenus *Musculium*; only at their bases in *Sphaerium* s.s.); embryos develop in each anterior gill in several thin-walled longitudinal sacs; byssal gland absent.

Subfamily Euperinae Heard, 1965

> Branchial and anal siphons are both present and typically well-separated for their entire length; each embryo develops in an individual spherical marsupial covering between the inner and outer lamellae of the anterior gills; byssal gland present and functional.

Subfamily Pisidiinae Baker, 1927

> The anal siphon is present, but the branchial siphon is absent (subgenus *Neopisidium*) or represented by a slit in the mantle (subgenera *Pisidium* s.s. and *Cyclocalyx*); embryos develop in each anterior gill in a thick-walled sac containing individual chambers for the embryos; byssal gland absent.

Sphaerium and *Pisidium* are cosmopolitan genera, and each contains many species. In North America there are 12 species of *Sphaerium* and 25 species of *Pisidium*. Besides the characters of soft anatomy listed above, the two genera can be readily distinguished by their shells. The posterior end of the shell is longer than the anterior end in *Sphaerium*, while just the reverse is true for *Pisidium*. (The anterior end of the shell covers the foot, and the posterior end of the shell surrounds the siphons. The anterior end of an empty shell can be distinguished by first determining which is the right and which is the left valve. The right valve contains only one cardinal tooth and two pairs of lateral teeth (Fig. 1). Conversely, the left valve has two cardinal teeth, but only two lateral teeth.)

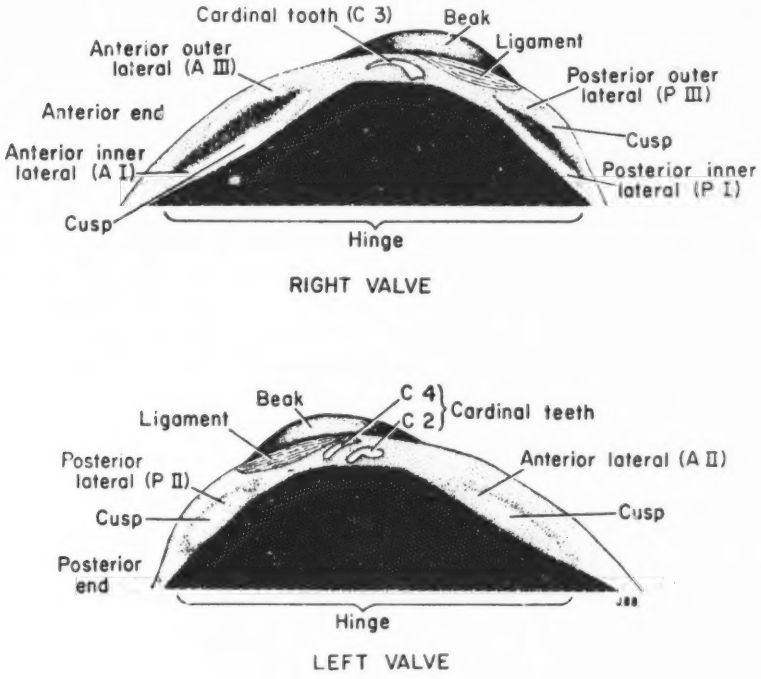


Fig. 1 - Hinge teeth terminology.

Eupera is represented in North America (north of Mexico) by only one species, *E. cubensis*, which is sporadically distributed in the Coastal Plain from southern Texas to central North Carolina.

The key which follows is based on the one I prepared (without illustrations) for a revision of the Sphaeriidae of North America by Herrington (1962). The present key is illustrated and contains several modifications, including the addition of three more species of *Pisidium*, and the genera *Eupera* and *Corbicula*.

COLLECTION, PRESERVATION AND IDENTIFICATION

Some equipment especially useful for collecting Sphaeriacea is shown in Fig. 2: a dip-net, drag dredge and sorting sieve. In addition, a round-pointed shovel and a 10- to 12-quart pail is recommended. When collecting on a soft bottom in shallow water (two feet or less), the shovel can be used to skim the surface of the bottom. The material obtained is then washed in the sieve. By nearly submerging the sieve in water, tipping and moving it slowly, most of the fine debris lighter than the specimens can be removed.

If the water depth exceeds two feet, or the bottom is very soft, the dipnet is more useful than the shovel. The dredge is used for depths greater than five feet, usually being dragged behind a rowboat, and the contents emptied into a tub in the boat.

Specimens to be used for anatomical study should be narcotized, i.e., relaxed in a life-like position and to such an extent that they do not contract when placed in fixative. One of the most common methods of narcotization is to add several menthol crystals to the shallow water vessel containing the specimens. However, a variety of other reagents can be used (see Runham, Isarankura and Smith, 1965), some with better results, some worse, depending on the species of mollusk.

Fixatives most commonly employed with freshwater mollusks are 65-75% ethyl alcohol or neutralized formalin. Formalin-alcohol-acetic acid and Bouin's fluid are also used, but since their acids dissolve the carbonates of the mollusk shell, fixation time should be carefully regulated if it is necessary to save the shell.

Freshwater mollusks are generally preserved in 60-70% ethyl alcohol, although neutralized 4% formalin or 1% propylene phenoxetol may also be used.

Corbicula and many of the species of *Sphaerium* can be identified easily without any magnification, or at most only a simple hand lens is needed. But to identify most species of *Pisidium*, a stereoscopic microscope with high magnification is necessary.

Fine forceps are needed to manipulate specimens and, because of the fragile nature of many pisidia shells, a small brush is also useful. Herrington (1961) recommends using tweezers made from a 3/4 x 6 inch celluloid strip bent around a 3/4 inch square block of wood.

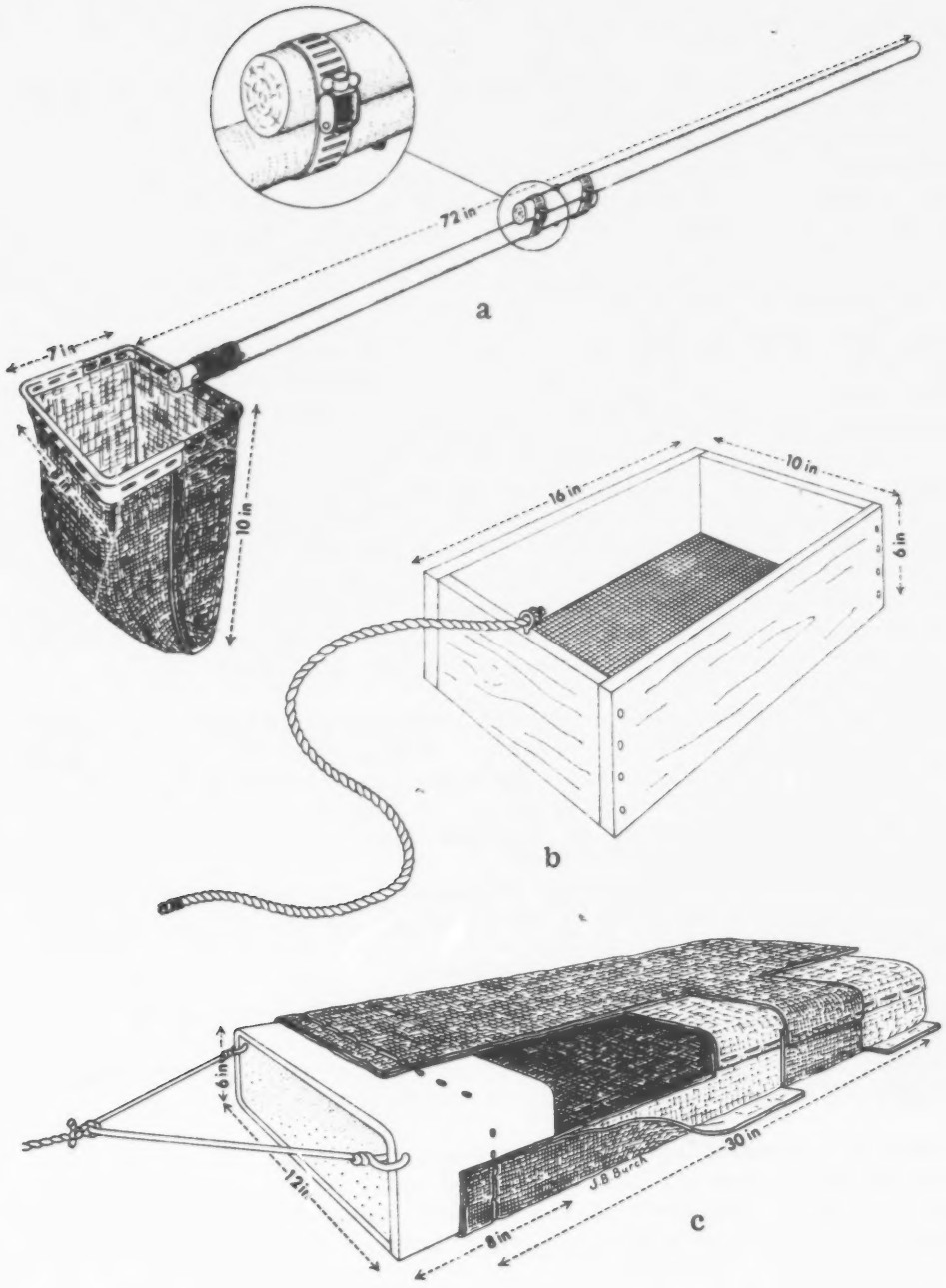


Fig. 2. a - Dip-net, made from round iron, a broom handle, and a piece of burlap; b - sieve, made from a wooden box, brass wire screening, and cord and screweye; c - drag dredge made from galvanized iron, two burlap potato sacks, a piece of wire, and some sash cord. From Herrington (1961).

SECTION II

SPECIES LIST AND RANGES

The geographical distributions given below are rather general ones, because many of the species have very wide ranges. For more detailed lists of distributions and localities, see Sinclair and Isom (1961, 1963), Herrington (1962), Heard (1963, 1965) and Clarke (in press). For additional details of taxonomy see Kuiper (1962, 1965), Herrington (1965) and Heard (1966, 1969).

Family CORBICULIDAE

Corbicula manilensis (Philippi, 1844). Introduced from east Asia and first noticed in Washington State in 1938. Since then it has spread south to California and across the United States to Florida, and in the Mississippi River system it has spread from Louisiana and Mississippi north to the upper Ohio River.

Family SPHAERIIDAE

Genus *Sphaerium* Scopoli, 1777

Subgenus *Sphaerium* s.s.

Sphaerium corneum (Linnaeus, 1758). Apparently introduced from Europe. It has been reported from several localities in southern Ontario, and in the United States from Lake Champlain (New York) and Lake Erie (Ohio).

Sphaerium fabale Prime, 1851. In Canada it occurs in southern Ontario. In the eastern United States this species is distributed from New York south to Georgia and Alabama. In the midwest it is found in Ohio, Michigan and Illinois.

Sphaerium nitidum Clessin, 1876. Holarctic in distribution. In the Western Hemisphere it occurs from northern Canada south to northern United States, where it extends from northern Maine west to Washington and the Aleutian Islands. This species has been reported from all the Great Lakes except Lake Erie. In the Rocky Mountains it extends south to Utah.

Sphaerium occidentale Prime, 1853. Sporadically distributed; in Canada from New Brunswick to southeastern Manitoba, and in the United States in all the northern states, south to Florida in the east and to Utah and Colorado in the west.

Sphaerium patella (Gould, 1850). Western United States: Washington, Oregon, Idaho and California.

Sphaerium rhomboideum (Say, 1822). Southern Canada from New Brunswick to British Columbia; northern United States from Maine and Pennsylvania to Idaho.

Sphaerium striatinum (Lamarck, 1818). In Canada from New Brunswick northwest to Great Slave Lake and the Upper Yukon River; throughout the United States and south into Mexico and Central America (Panama).

Sphaerium simile (Say, 1816). Southern Canada from New Brunswick to northern and central British Columbia, south to Virginia, Iowa and Wyoming.

Subgenus *Musculium* Link, 1807

Sphaerium (Musculium) lacustre (Müller, 1774). From the tree-line in Canada and Alaska south, throughout Canada and the United States (except the southwestern states). Also found in Hawaii, Central and South America, Australasia and Eurasia.

Sphaerium (Musculium) partumeium (Say, 1822). In southern Canada from New Brunswick to Saskatchewan. It is found throughout the United States.

Sphaerium (Musculium) securis Prime, 1851. In Canada from Nova Scotia west to British Columbia and southwestern Northern Territories. It is recorded from most of the United States except the southwestern states.

Sphaerium (Musculium) transversum (Say, 1829). North America from southwestern Northwest Territories, the Canadian provinces and United States east of the Rocky Mountains, south to Florida, Texas and Mexico.

Genus *Eupera* Bourguignat, 1854

Eupera cubensis (Prime, 1865). Atlantic Coastal Plain from southern Texas to central North Carolina. Also found in Central America and northern South America.

Genus *Pisidium* Pfeiffer, 1821

Subgenus *Pisidium* s.s.

Pisidium amnicum (Müller, 1774). Eurasia and Africa. Introduced into North America and found mainly around the eastern Great Lakes and the St. Lawrence River. Also reported from Pennsylvania, New Jersey and Lake Champlain.

Pisidium dubium (Say, 1816). North America east of the Mississippi River from southern Ontario to Florida.

Pisidium idahoense Roper, 1890. Southern Canada and the Great Lakes region of the United States west to the Aleutian Islands, British Columbia, Washington and California.

Subgenus *Cyclocalyx* Dall, 1903

Pisidium (Cyclocalyx) adamsi Prime, 1852. In Canada from Nova Scotia west to Saskatchewan. Reported from nearly all of the United States east of the Rocky Mountains except for the southcentral states.

Pisidium (Cyclocalyx) casertanum (Poli, 1795). Nearly cosmopolitan in distribution. It has been reliably recorded from all of the United States except Hawaii, Kentucky and North Dakota.

Pisidium (Cyclocalyx) compressum Prime, 1852. Found throughout most of Canada and the United States, and into Mexico.

Pisidium (Cyclocalyx) equilaterale Prime, 1852. Southeastern Canada to eastern Lake Superior, south to Virginia, Pennsylvania and Illinois.

Pisidium (Cyclocalyx) fallax Sterki, 1890. Distributed sporadically from Great Slave Lake, Alberta and western James Bay south through southern Canada and northern United States from Washington to New Jersey. Also recorded from Alabama.

Pisidium (Cyclocalyx) ferrugineum Prime, 1852. Found in most of Canada and distributed south to the northern United States from Washington and Utah to New Jersey.

Pisidium (Cyclocalyx) henslowanum (Sheppard, 1825). Reported from several localities in the eastern Great Lakes region. Apparently introduced into North America, probably from Europe.

Pisidium (Cyclocalyx) lilljeborgi Clessin, 1886. Northern Canada and Alaska south throughout Canada and the northern United States, and in the Rocky Mountains south to Colorado, Utah and California.

Pisidium (Cyclocalyx) milium Held, 1836. Aleutian islands and Great Slave Lake, south to British Columbia, James Bay, Prince Edward Island and Maine, and south in the Rocky Mountains to Utah and Colorado.

Pisidium (Cyclocalyx) nitidum Jenyns, 1832. In most parts of the continental United States except Alaska, and in all Canadian provinces except Nova Scotia. Also in Mexico, Eurasia and North Africa.

Pisidium (Cyclocalyx) rotundatum Prime, 1851. Northern Canada to the northern United States from Maine to Washington, south in the Rocky Mountains to Mexico; Oklahoma.

Pisidium (Cyclocalyx) subtruncatum Malam, 1855. Northern and central Canada to the northern United States from New York to Montana, and south in the Rocky Mountains to Colorado and California.

Pisidium (Cyclocalyx) supinum Schmidt, 1850. Found at several localities in the eastern Great Lakes region. Apparently an introduced species, probably from Europe.

Pisidium (Cyclocalyx) ultramontanum Prime, 1865. Known only from several localities in southwestern Oregon and northern California.

Pisidium (Cyclocalyx) variabile Prime, 1852. Found throughout Canada and the United States.

Pisidium (Cyclocalyx) ventricosum Prime, 1851. Northern Canada to the northern United States from Maine to Washington, south in the Rocky Mountains to Mexico.

Pisidium (Cyclocalyx) walkeri Sterki, 1895. Northern Canada south to Virginia and Arizona.

Subgenus *Neopisidium* Odhner, 1921

Pisidium (Neopisidium) conventus Clessin, 1877. Holarctic, usually in arctic, subarctic or alpine lakes. Found in many localities in Canada, in several of the Great Lakes, and in Alaska, Washington, Montana, Wisconsin and New York.

Pisidium (Neopisidium) cruciatum Sterki, 1895. Central Great Lakes region of the United States and southern Ontario.

Pisidium (Neopisidium) insigne Gabb, 1868. Southern Ontario and British Columbia in Canada. In the northern United States from Maine to Washington, south in the Rocky Mountains to the southern border states.

Pisidium (Neopisidium) punctatum Sterki, 1895. Southern Canada and the Great Lakes region of the United States south to Ohio, Pennsylvania, Virginia and Tennessee.

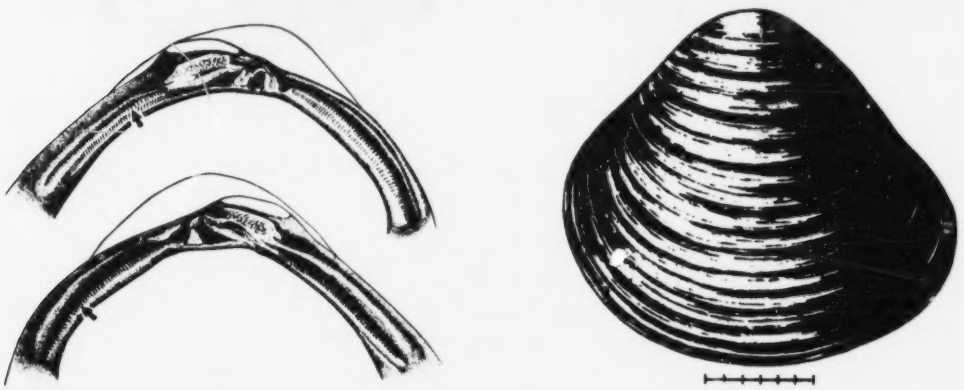
Pisidium (Neopisidium) punctiferum Guppy, 1867. In the United States found only in Florida and Texas. Additional distribution: Mexico, Central America and Caribbean islands.

SECTION III

KEY TO THE NORTH AMERICAN SPHAERIACEA

All scale lines in figures are marked off in mm.

1 Hinge of shell with serrated lateral teeth (Fig. 3a,b). Corbiculidae: *Corbicula manilensis*
Hinge of shell with smooth lateral teeth. Sphaeriidae..... 2



a b

Fig. 3. *Corbicula manilensis*. a - Hinge; b - External view of left valve.

2 (1) Beaks of shell anterior, or if subcentral, on the anterior side of center (Fig. 4a). *Sphaerium, Eupera*..... 3
Beaks of shell posterior, or if subcentral, on the posterior side of center (Fig. 4b). *Pisidium*.....18

a b

Fig. 4. Sphaeriidae, beak positions as seen from left side of shell. a - Beaks anterior; b - Beaks posterior.

3 (2) Shell with two cardinal teeth in one valve, and one in the opposing valve; shell without mottling..... 4
Shell with only one cardinal tooth in each valve; shell usually mottled (Fig. 5a): *Eupera cubensis*

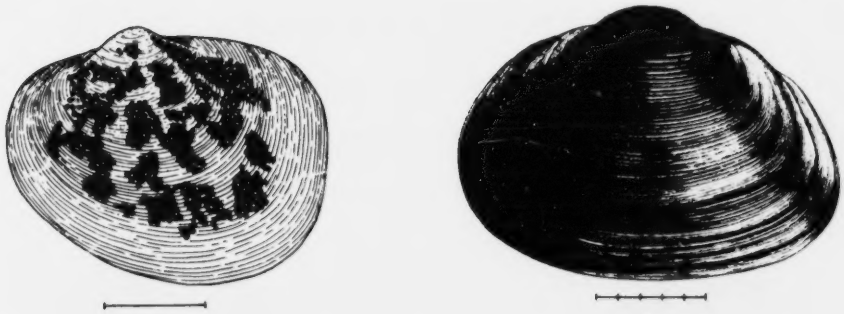


Fig. 5. Sphaeriidae, left valves. a - *Eupera cubensis*; b - *Sphaerium simile*.

4 (3) Shell sculptured with coarse striae or relatively widely spaced striae (8 or less per mm in the middle of the shell)..... 5
Shell sculptured with fine striae or relatively narrowly spaced striae (12 or more striae per mm in the middle of the shell).7

5 (4) Striae evenly spaced (Fig. 5b): *S. simile*
Striae not evenly spaced..... 6

6 (5) Surface even, except for rest marks and striae; shell inflated; striae not weaker in region of the beaks (Fig. 6a): *S. striatinum*
Surface uneven; shell compressed; striae weaker in region of the beaks (Fig. 6b): *S. fabale*

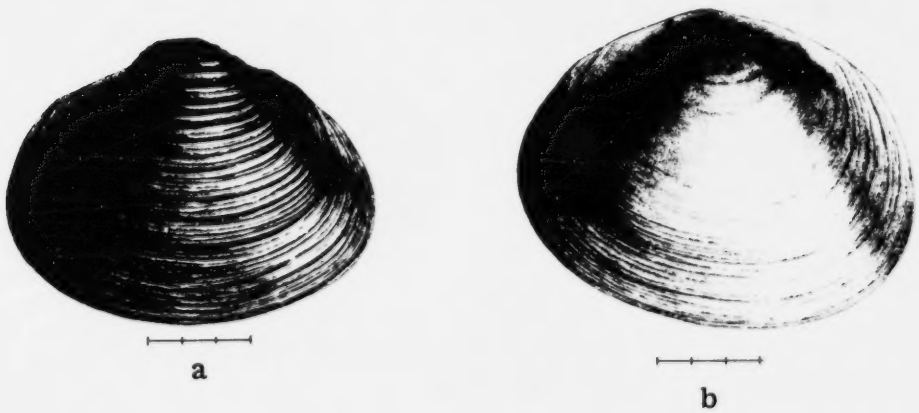


Fig. 6. *Sphaerium*, left valves. a - *S. striatinum*; b - *S. fabale*.

7 (4) Adult shell large, more than 8 mm in length..... 8
Adult shell smaller, less than 8 mm in length 13

8 (7) Beaks prominent, distinctly raised above the dorsal margin 9
Beaks not prominent, only very slightly raised above the dorsal margin..... 11

9 (8) Shell long in outline, height 3/4 or less of the length (Fig. 7a): *S. transversum*
Shell higher in outline, height 7/8 or more of the length..... 10

10 (9) Dorsal margin rather straight, posterior end more or less at right angles to the dorsal margin; striae very fine (Fig. 7b): *S. partumeium*
Dorsal margin more rounded, posterior end at a greater angle to the dorsal margin; striae coaser (Fig. 8a): *S. lacustre*

Fig. 7. *Sphaerium*, left valves. a - *S. transversum*; b - *S. partumeium*.

11 (8) Shell more or less rectangular in outline (Fig. 8b): *S. rhomboideum*
Shell with more rounded ends 12

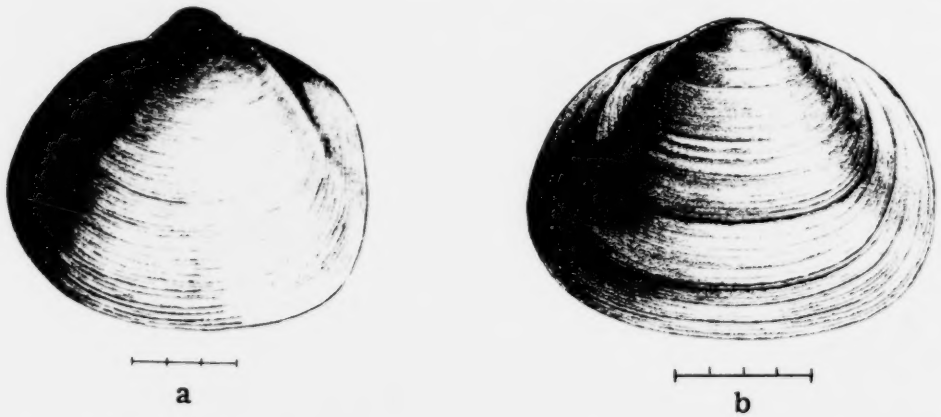
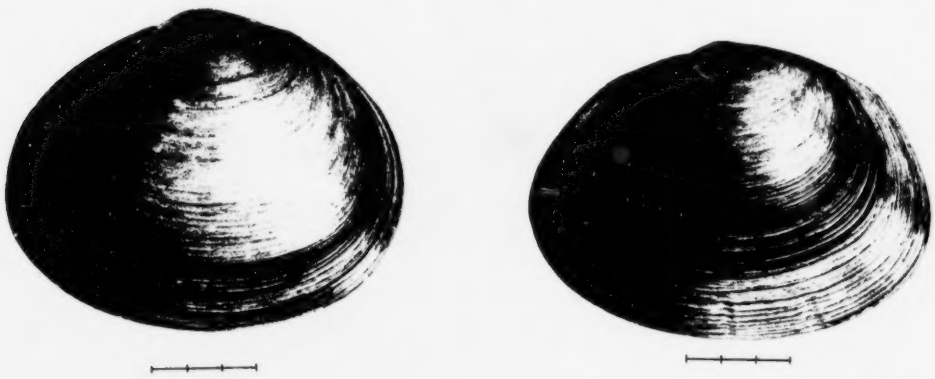


Fig. 8. *Sphaerium*, left valves. a - *S. lacustre*; b - *S. rhomboideum*.

12 (11) Ends of shell rounded in outline (Fig. 9a): *S. corneum*
Ends of shell distinctly tapering toward the beaks (Fig. 9b): *S. patella*



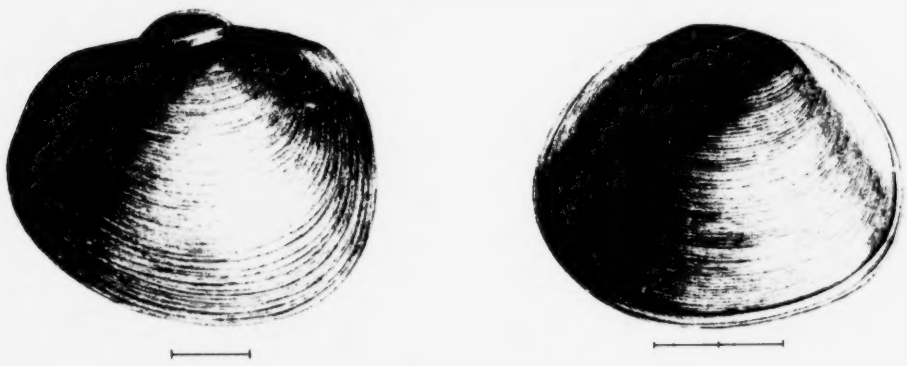
a b

Fig. 9. *Sphaerium*, left valves. a - *S. corneum*; B - *S. patella*.

13 (7) Posterior end nearly at right angles to the dorsal margin..... 14
Posterior end and dorsal margin rounded or forming an obtuse angle..... 15

14 (13) Anterior ventral margin of shell slopes sharply upward; surface dull; striae coarser (Fig. 10a): *S. securis*
Anterior ventral margin of shell slopes upward, but only slightly; surface glossy; striae finer (Fig. 7b): *S. partumeium*

15 (13) Striae maintain their spacing and height in the region of the beaks (Fig. 10b): *S. nitidum*
Striae fade out in region of beaks.....16



a b

Fig. 10. *Sphaerium*, left valves. a - *S. securis*. b - *S. nitidum*.

16 (15) Beaks prominent, distinctly raised above the dorsal margin....17
Beaks not prominent, only slightly raised above the dorsal margin (Fig. 9a): *S. corneum*

17 (16) Anterior and posterior ends of shell round; beaks not swollen (Fig. 11a): *S. occidentale*
Posterior end of shell truncate; beaks swollen (Fig. 11b): *S. lacustre*

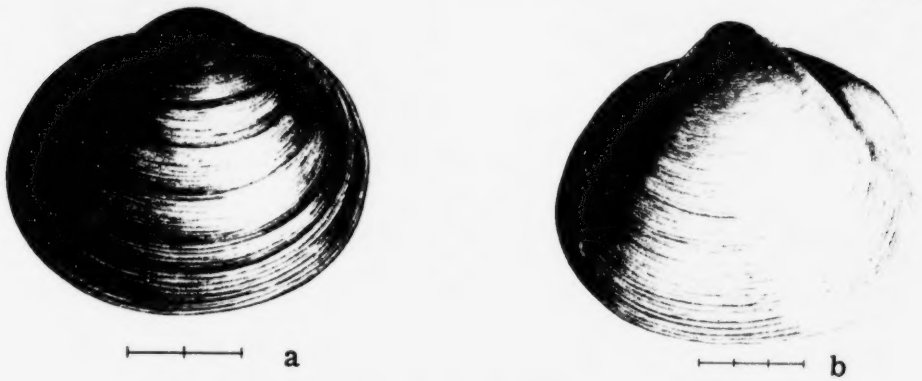


Fig. 11. *Sphaerium*, left valves. a - *S. occidentale*; b - *S. lacustre*.

18 (2) Shell large, adults 6 mm or more in length.....19
Shell medium or small, adults less than 6 mm in length 22

19 (18) Striae coarser (10 or less per mm).....20
Striae finer (15 or more per mm).....21

20 (19) Striae fade out in region of beaks; cardinal teeth nearer the posterior lateral teeth than to the anterior lateral teeth (Figs 12a, 13a): *Pisidium dubium*
Striae do not fade out in the region of beaks; cardinal teeth nearer the anterior lateral teeth than to the posterior lateral teeth (Figs 12b, 13b): *P. amnicum*

Fig. 12. *Pisidium*, hinge of right valves. a - *P. dubium*; b - *P. amnicum*.

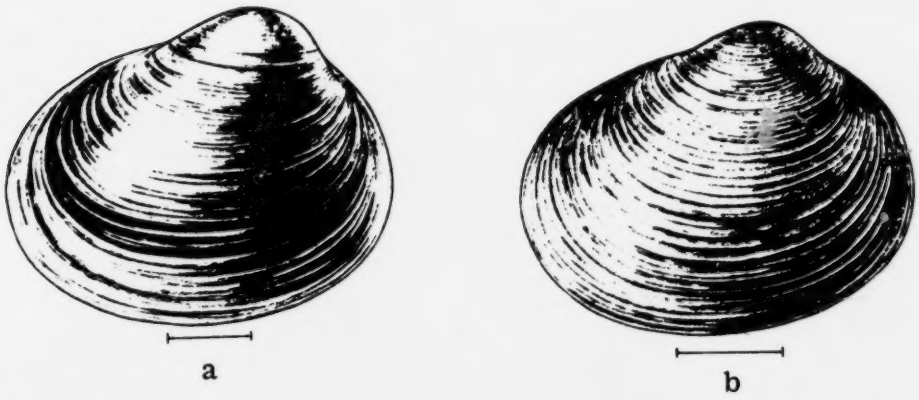


Fig. 13. *Pisidium*, left valves. a - *P. dubium*; b - *P. amnicum*.

21 (19) Shell long in outline, height less than 90% of the length; surface dull (Fig. 14a): *P. adamsi*
Shell higher in outline, height 90% or more of the length; surface glossy (Fig. 14b): *P. idahoense*

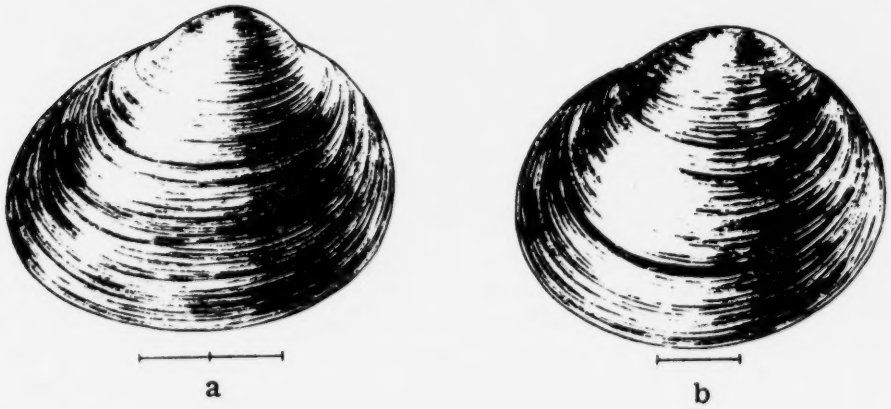


Fig. 14. *Pisidium*, left valve. a - *P. adamsi*; b - *P. idahoense*.

22 (18) Anterior cusp of left valve twisted toward the anterior, and the corresponding sulcus on the right valve twisted correspondingly (Fig. 15a): *P. fallax*
Anterior cusp of left valve not twisted, but parallel to the dorsal margin.....23

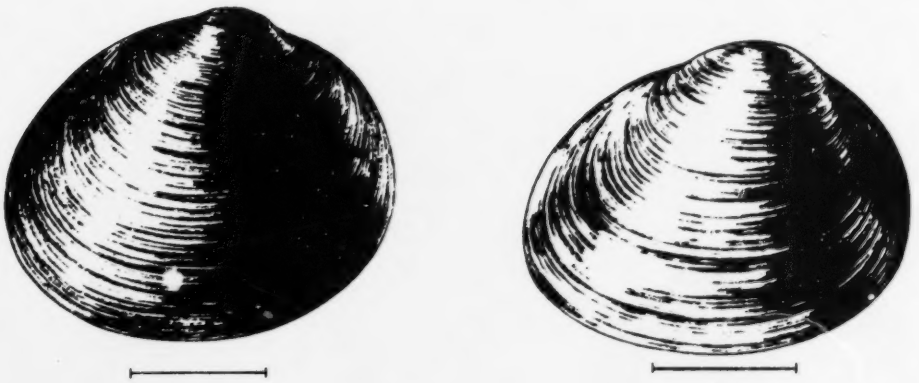


Fig. 15. *Pisidium*, left valves. a - *P. fallax;* b - *P. milium.*

23 (22) Ventral aspect of shell very truncate (in end view) (Fig. 15b): *P. milium*
Shell tapering ventrally.....24

24 (23) Hinge long (more than 3/4 the shell length).....25
Hinge short (less than 3/4 the shell length).....36

25 (24) Anterior end terminating in a long blunt point (Fig. 16a): *P. insigne*
Anterior end rounded.....26

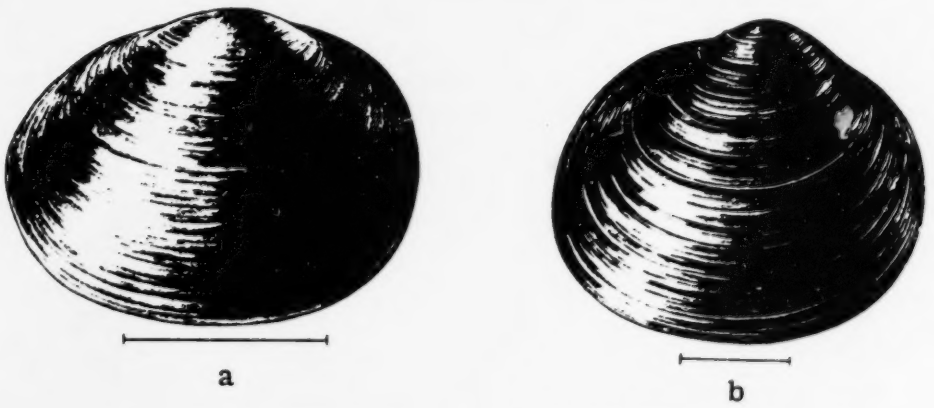


Fig. 16. *Pisidium*, left valves. a - *P. insigne;* b - *P. ultramontanum.*

26 (25) Shell with heavy ridges which go beyond the beaks; California and Oregon (Fig. 16b): *P. ultramontanum*
Shell without heavy ridges, or if present, only on the beaks..27

27 (26) Cardinal teeth central or subcentral.....28
Cardinal teeth near anterior cusps.....35

28 (27) Shell shaped like a parallelogram, i.e., the anterior and posterior ends slope parallel and nearly at the same angle; found only in cold waters (Fig. 17a): *P. conventus*
Anterior and posterior ends slope at different angles, i.e., not parallel.....29

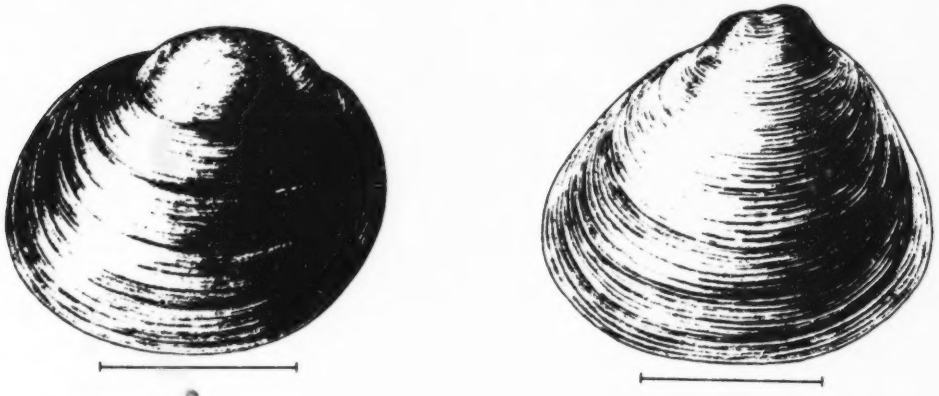


Fig. 17. *Pisidium*, left valves. a - *P. conventus;* b - *P. cruciatum.*

29 (28) Shell dull.....30
Shell glossy.....33

30 (29) Shell with ridges on the beaks.....31
Shell without ridges on the beaks.....32

31 (30) Beak ridges U-shaped (Figs. 17b, 18a): *P. cruciatum*
Beak ridges straight or slightly curved, but not U-shaped (Figs. 18b, 19): *P. compressum*

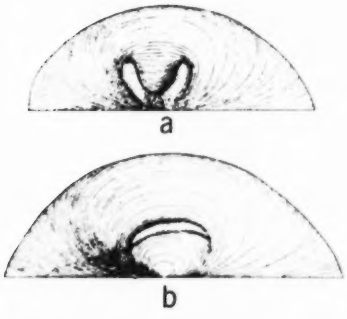


Fig. 18. *Pisidium*, beak sculpture a - *P. cruciatum;* b - *P. compressum.*

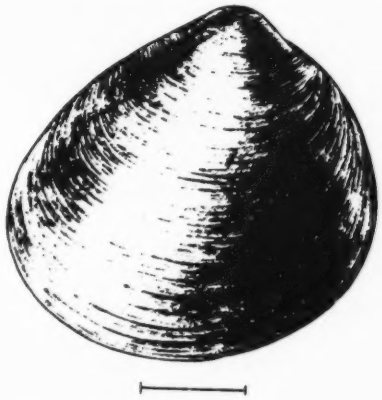


Fig. 19. *P. compressum*, left valve.

32 (30) Shell medium-sized, up to 3 mm in length; sculptured with very fine close striae (Fig. 20a): *P. punctiferum*
Shell minute, 1.5 mm or less in length; striae prominent and rather widely spaced (Fig. 20b): *P. punctatum*

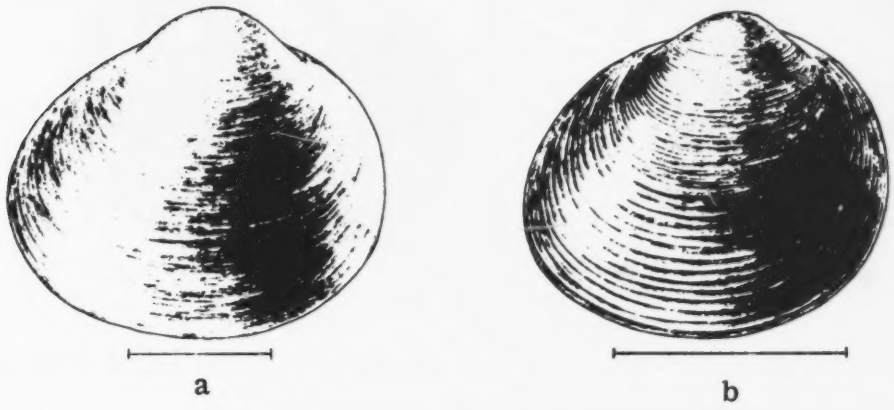


Fig. 20. *Pisidium*, left valves. a - *P. punctiferum*; b - *P. punctatum*.

33 (29) Beaks prominent; moderately striate (less than 30 striae per mm)..... 34
Beaks not prominent; finely striate (more than 30 striae per mm) (Fig. 21): *P. nitidum*

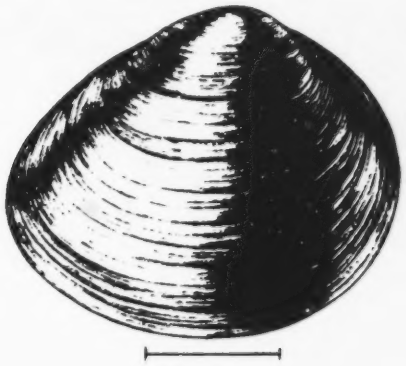


Fig. 21. *Pisidium nitidum*, left valve.

34 (33) Beaks subcentral (Fig. 22a): *P. equilaterale*
Beaks posteriorly placed (Fig. 22b): *P. variabile*

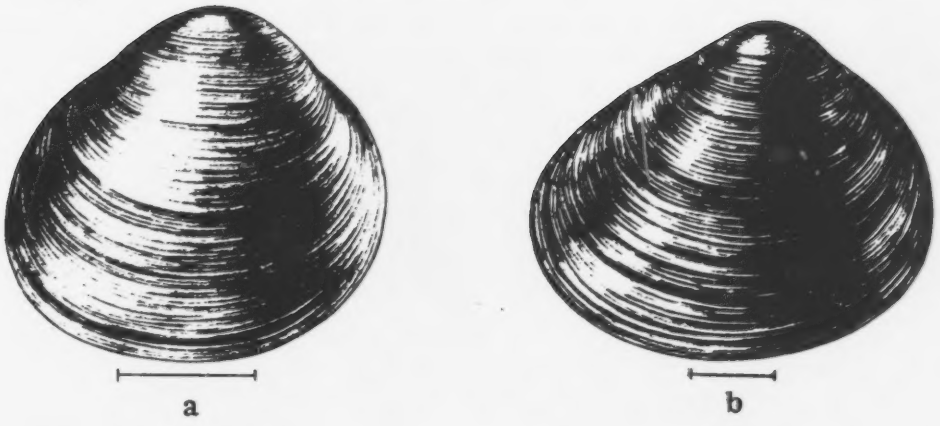


Fig. 22. *Pisidium*, left valves. a - *P. equilaterale;* b - *P. variabile.*

35 (27) Cusp of AII with nearly vertical and parallel sides (Figs 23a, 24a): *P. ferrugineum*
Cusp of AII may have steeply inclined sides, but not nearly vertical or parallel (Figs 23b, 24b): *P. casertanum*

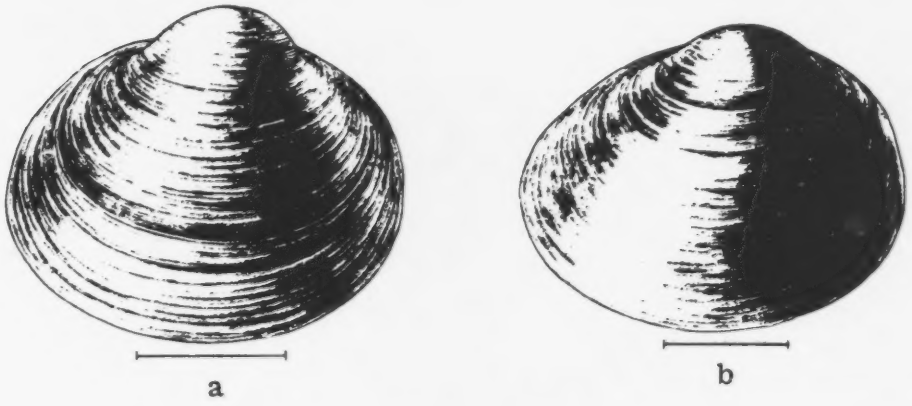


Fig. 23. *Pisidium*, left valves. a - *P. ferrugineum*. b - *P. casertanum.*

36 (24) PII central, or on proximal side of center (Fig. 25a).....37
PII distal, or on distal side of center (Fig. 25b).....40

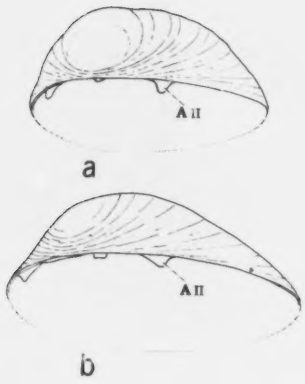


Fig. 24. *Pisidium*, cusps of lateral teeth AII. a - *P. ferrugineum*; b - *P. casertanum*.

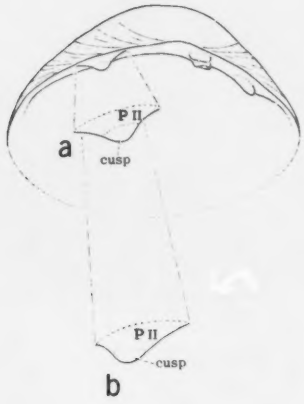


Fig. 25. *Pisidium*, cusps of of lateral teeth PII. a - cusps central; b - cusps distal.

37 (36) Surface glossy; finely striate (more than 30 striae per mm)...38
Surface dull; moderately striate (less than 30 striae per mm) (Fig. 26a): *P. walkeri*

38 (37) Anterior (proximal) end of sulcus in right valve closed.....39
Anterior (proximal) end of sulcus in right valve not closed (Fig. 26b): *P. subtruncatum*

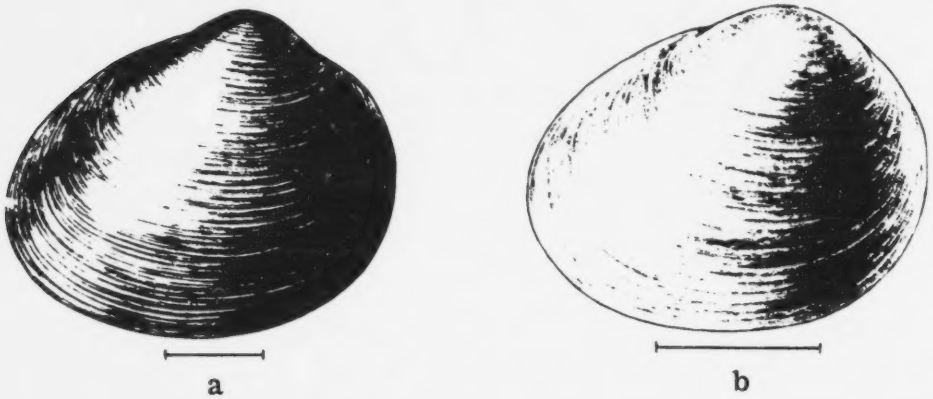


Fig. 26. *Pisidium*, left valves. a - *P. walkeri*; b - *P. subtruncatum*.

39 (38) Beaks subcentral; hinge plate between cardinals and AII narrow (Figs 27a, 28a): *P. rotundatum*
Beaks posterior; hinge plate between cardinals and AII relatively wide (Figs 27b, 28b): *P. ventricosum*

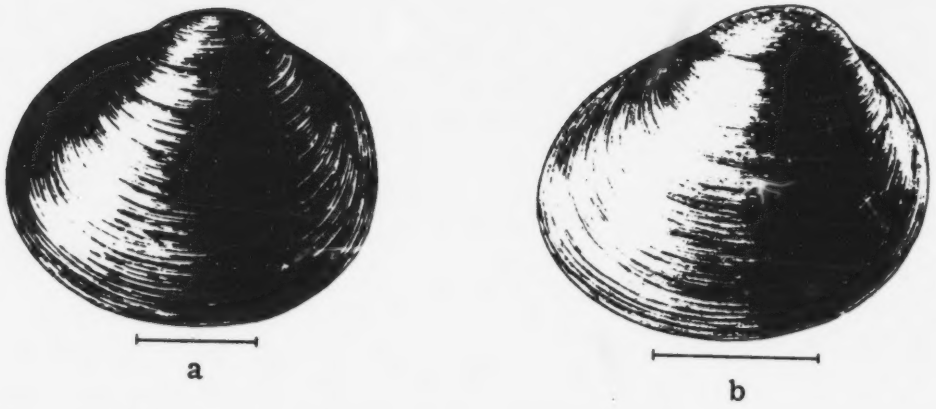


Fig. 27. *Pisidium*, left valves. a - *P. rotundatum*; b - *P. ventricosum*.

40 (36) Anterior end joining dorsal margin at an angle (Figs 29a,30): *P. lilljeborgi*
Anterior end curves gently into the dorsal margin (Fig. 29b)..41

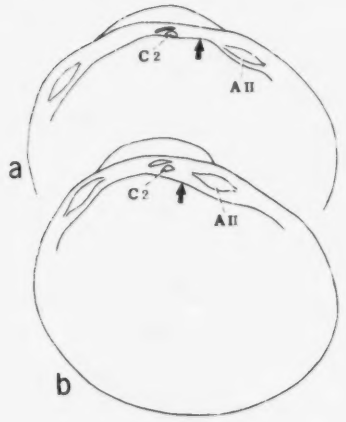


Fig. 28. *Pisidium*, hinge plates. a - *P. rotundatum*; b.- *P. ventricosum*.

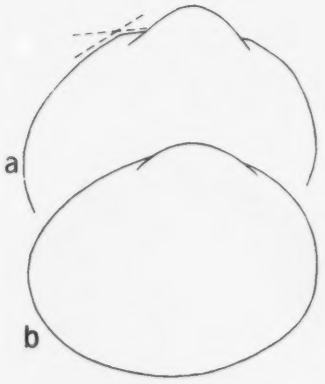


Fig. 29. *Pisidium*, anterior and dorsal margins. a - anterior end joining dorsal margin at an angle; b - anterior end curves gently into the dorsal margin.

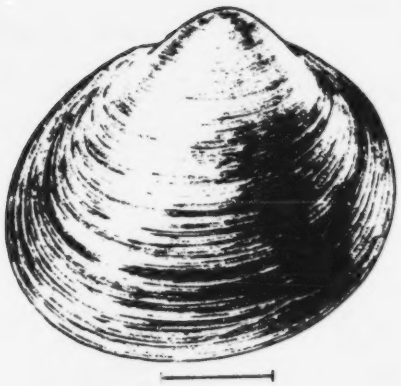


Fig. 30. *P. lilljeborgi*, left valve.

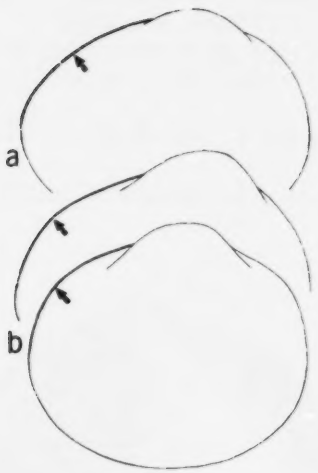


Fig. 31. *Pisidium*, dorsal margins. a - almost straight; b- rounded.

41 (40) PII central or on distal side of center; beaks never ridged...42
PII distal; beaks usually ridged.....44

42 (41) Dorsal margin anterior of beak almost straight or only faintly curved (Fig. 31a); beaks not prominent (Figs 23b, 32b): *P. casertanum*
Dorsal margin anterior to beak well rounded (Fig. 31b); beaks prominent (Fig. 32a).....43

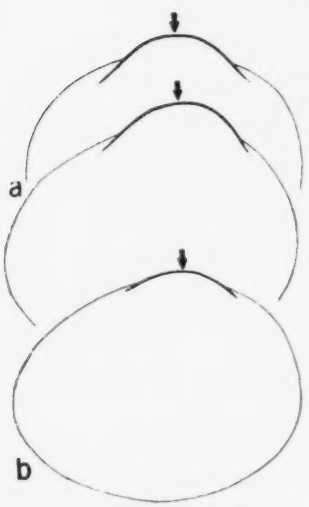


Fig. 32. *Pisidium* beaks. a - prominent; b - not prominent.

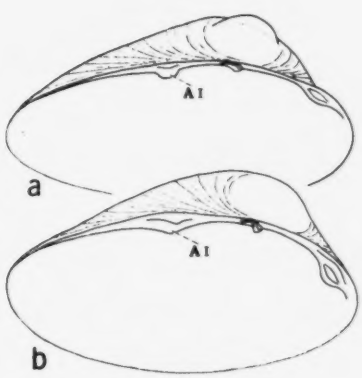


Fig. 33. AI cusps of lateral teeth of *Pisidium*. a - sides steeply sloped; b - sides gently sloped.

43 (42) Beaks subcentral; hinge plate between cardinals and AII narrow (Figs 27a, 28a): *P. rotundatum*
Beaks posterior; hinge plate between cardinals and AII relatively wide (Figs 27b, 28b): *P. ventricosum*

44 (41) Cusp of AI thin and with steeply sloped sides (Figs 33a, 34a): *P. henslowanum*
Cusp of AI thick and with gently sloped sides (Figs 33b, 34b): *P. supinum*

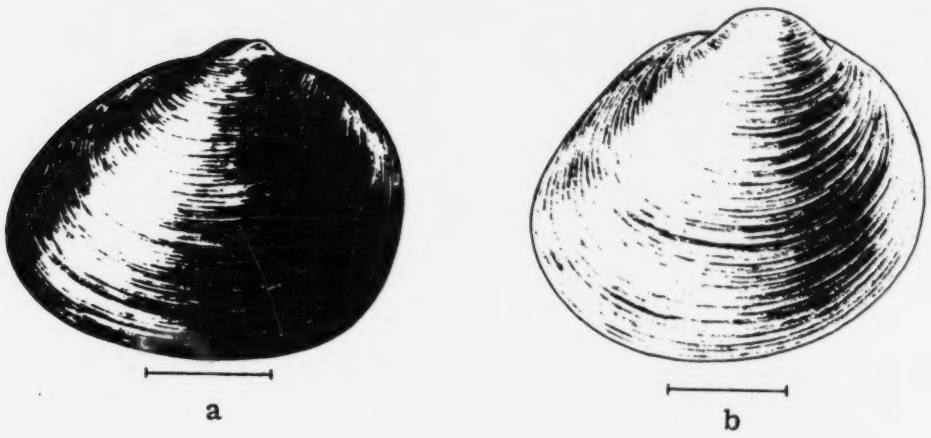


Fig. 34. *Pisidium*, left valves. a - *P. henslowanum*; b - *P. supinum*.

SECTION IV

ACKNOWLEDGEMENTS

Figs 4-11 were drawn by John Tottenham; Figs 3, 13-17, 19-23, 26, 27, 30 and 34 were drawn by Martha Lackey.

SECTION V

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SECTION VI

GLOSSARY

Anal siphon. The dorsal exhalant tube derived from mantle-margin epithelium and located near the anus at the posterior end of the animal. Water currents from inside the mantle flow through the anal siphon to the outside.

Anterior end. The shorter end of the shell (from the beaks) in *Corbicula*, *Eupera* and *Sphaerium;* the longer end of the shell in *Pisidium*. The foot of the animal is directed toward this end.

Beaks. The raised part on the dorsal margin of the shell. It is formed by the embryonic shell around which the later shell develops.

Branchial siphon. The ventral inhalant tube derived from mantle-margin epithelium. It is located at the posterior end of the animal and through it flows outside water carrying dissolved oxygen, food organisms and male gametes.

Byssal gland. A gland embedded in the posterior portion of the foot which secretes adhesive-tipped threads that anchor certain bivalved mollusks to the substratum.

Cardinal teeth. Lamellae on the center of the hinge in the right and left valves which function to stabilize the two valves against shearing forces. The opposing cardinal teeth of the two valves fit together in a complementary fashion. There are usually two cardinal teeth in the left valve and one in the right; sometimes this order is reversed.

Compressed. Flattened laterally.

Cusps. The highest elevations on the lateral teeth.

Depressed. Flattened dorso-ventrally.

Distal. Farthest from the beaks of the shell in an anterior-posterior axis.

Dorsal Margin. The upper edge of the shell, including the hinge.

Fingernail clam. Common or vernacular name for a member of the genus *Sphaerium*.

Hinge. The stabilizing lamellae (cardinal and lateral teeth) in the dorsal part of each valve of a pelecypod shell. The opposing single lamella in the sphaeriacean shell articulates with a pair of complementary lamellae in the opposing valve.

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Hinge plate. That part of the dorsal margin of the shell between the anterior and posterior lateral teeth of each valve, and including the lateral teeth.

Inflated. Swollen.

Lateral teeth. The elongated lamellae at each end of the hinge-plate.

Left valve. The shell half on the left side when the shell is placed with the hinge up and the anterior end forward.

Mantle. An extension of the dorsal body wall of mollusks as one or a pair of folds, which usually secretes a shell and encloses a mantle cavity, typically containing gills.

Pea clam. Common or vernacular name for a member of the genus *Pisidium* (same as "pill clam").

Pill clam. Common or vernacular name for a member of the genus *Pisidium* (same as "pea clam").

Posterior end. The longer end of the shell (from the beaks) in *Corbicula, Eupera* and *Sphaerium;* the shorter end of the shell in *Pisidium.* This is the end from which the siphons extend.

Proximal. Nearest the beaks of the shell in an anterior-posterior axis.

Rest mark. A darker or thicker part of the shell characteristically formed during a rest period in growth.

Ridge. A wrinkle or raised part on the beaks of some species of *Pisidium.*

Right valve. The shell half on the right side when the shell is placed with the hinge up and the anterior end forward

Serrated. Notched on the edge.

Siphons. Fleshy tubes at the posterior end of bivalved mollusks through which inhalant and exhalant water passes into and out of the mantle cavity.

Sphaeriacea. A superfamily of bivalved mollusks (Class Pelecypoda or Bivalvia, Subclass Lamellibranchia, Order Heterodonta) living in fresh or brackish water and characterized by a porcelainous shell, round, triangular or oval in shape, and with cardinal "teeth" or lamellae below the beaks and usually well-developed lateral "teeth" at each end of the hinge plate. An external ligament holds the two shell valves together. The hermaphroditic, ovoviviparous animal contains branchial sacs or spaces in which the young are brooded.

Striae. Concentric raised striations or lines on the exterior surface of the shell. They may vary from fine to very coarse, the latter sometimes called ribs.

Subcentral. Not quite central; off-center.

Sulcus. A longitudinal furrow, one usually at each end of the hinge plate of the right valve, which serves as a socket for the teeth of the opposing (left) valve.

Teeth. The opposing lamellae on the hinge plates of bivalved mollusks which serve to stabilize the two valves against shearing forces. In the Sphaeriacea the central lamellae near the beaks are called cardinal teeth and the lamellae at each end of the hinge plates are called lateral teeth.

Truncate. Having the end cut off more or less squarely.

Valve. The single undivided shell of non-pelecypod mollusks, or one of the opposing halves of the divided shell of a pelecypod mollusk. In bivalved mollusks the two shell halves are held together by an elastic ligament.

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